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Design of a High-Rise Structure on an Oblique Ground Taking Earthquake Resistance

Devanand Kumar, Mr. Raushan Kumar

School of Engineering Eklavya University, Damoh, Madhya Pradesh, India

ABSTRACT

The study of straightforward 2-D frames with different floor heights and different numbers of bays using the widely used software programme STAAD Pro. The maximum axial force, maximum shear force, maximum bending moment, maximum tensile force, and maximum compressive stress created for the frames on plain ground and sloping ground were compared using a variety of graphs using the analytical findings. The graphs that were used to compare the two situations and the in-depth analysis of the "SHORT COLOUMN EFFECT" Rejection was carried up. Additionally, a thorough examination of seismology was conducted, and the viability of the intended software tool was also examined. Numerous projects of this nature have been completed on this subject in the past, but the analysis was often done for static loads, such as dead load, live load, etc. To this, earthquake analysis or seismic analysis has to be included. Two identical kinds of constructions, one on level ground and the other on a sloping ground, were examined in order to develop technical expertise. The outcomes were then contrasted. Finally, a manually planned structure on sloping land would be evaluated for all feasible load combinations according to IS 456 and IS 1893 and IS 13920.

KEYWORDS: *earthquake analysis, structures, shear force, bending moment, compressive, stress*

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I. INTRODUCTION

High rise building seismic design has gained significant relevance recently. For structures of small height subjected to earthquakes of very low intensity, traditional methods based on the fundamental mode of the structure and distribution of earthquake forces as static forces at various stories may be adequate, but as the number of stories increases, the seismic design becomes more rigorous.

The shorter columns in reinforced concrete (RC) frame buildings with columns of varying heights within one level sustained more damage during previous earthquakes than the higher columns within the same floor. The following two examples of structures with short columns are structures with mezzanine floors and structures on sloping terrain.

OBJECTIVES

Following are the main objective of the present study:

a) To examine a multi-story steel frame building's seismic performance

b) When unbraced and then with various bracing arrangements, such as cross bracing in the shape of a 'X' and diagonal bracing, utilising Equivalent Static analysis, Response Spectrum analysis, and linear Time History analysis.

c) To examine the seismic response of a multi-story steel frame building with the same bracing design but different story counts, or different building heights.

II. Literature review

Shendkar and Kumar (2018) studied the out of plane behaviour of infills using two types of infill panels: semi-interlocked masonry and unreinforced masonry. Using the seismostruct finite element analysis programme, the nonlinear static pushover study is carried out to explore the nonlinear behaviour of infill panels. Modelled as double strut diagonal, the panels model to take into consideration infills' nonlinear out of plane behaviour. Additionally calculated are the response reduction factors for RC frames. Seven distinct numerical models, including bare frame, open ground storey, complete infill, side bay in filled with

URM, and subsequently with semi interlocked masonry in fills, are employed for examination in this work. They noticed that when frames include infills, both the ductility reduction factor and ductility are reduced. On the other side, adding infill to the frames raises the strength factor. Semi interlocked in fills have a larger response reduction factor and base shear value than other types. The R factor also relies on the materials and how they are arranged geometrically in the frames.

In order to comprehend the seismic performance of reinforced concrete structures that are fully and partially filled with masonry,

Abdelaziz et al. (2019) performed a research. They created models of high-rise, medium-rise, and low-rise structures with various infill arrangements and variable story heights. There are four different types of frames in the configuration: bare, filled, open ground story, and partially opened ground story. The structural software programme SeismoStruct software is used to do the dynamic time-history analysis and develop the double strut nonlinear cyclic model for infill walls. Along with findings from static pushover and dynamic analyses, the analysis results are parametrically compared. The arrangements of infill walls are seen to have an impact on the frames. In terms of narrative drifts, lateral capacity, and displacement control, the RC frames perform better because to its regular distribution. At the level when infill walls are removed and the columns in this story are more susceptible to collapsing, the soft story phenomenon increases the drift ratios.

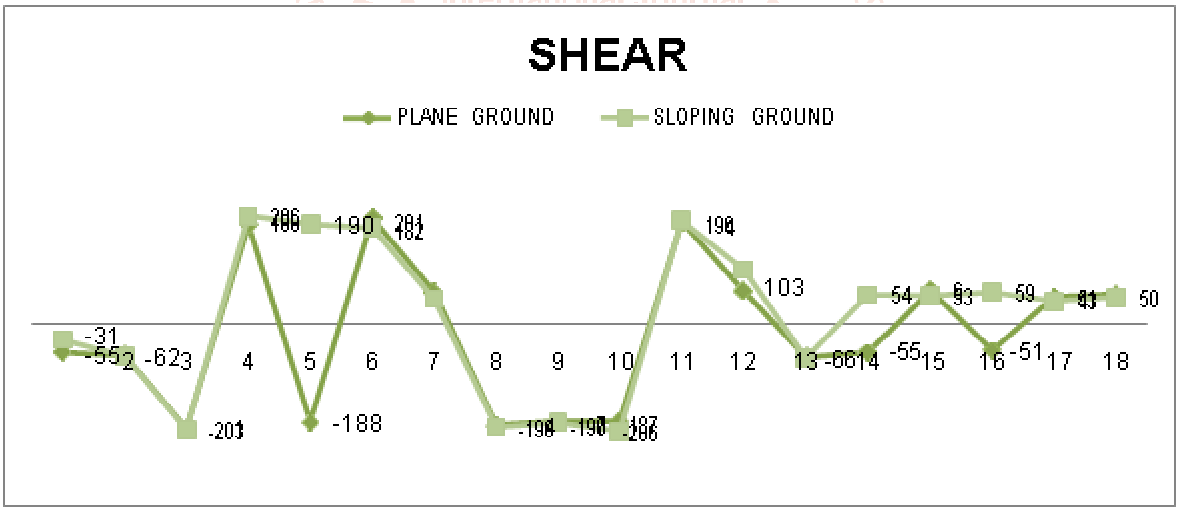
Soni et al. (2019) STAAD.pro software was used to compare the base shear and time period of multi-story moment resistant frames of varied configurations and varying heights during the nonlinear analysis of moment resisting frames under dynamic excitation. Additionally investigated is the base shear of several modal combination techniques for various configurations. SRSS (Square Root of Summation of Squares technique), 10PCT (10% method), ABS (Absolute Sum method), and CSM (Closely- Spaced Modes grouping method) are some of the combination methods. For various multi-bay and diverse column seize configurations, the storey height changed from the ground level to G+ 11 story. For the purpose of analysing the structural reaction, models for each level and each configuration were examined. They discovered that the structure's design is significantly influenced by the time period and base shear. Additionally, it was discovered that the setting of a number of factors affects how long the structure lasts. In comparison to other approaches, the base shear calculated using the SRSS method is more conservative. Additionally, it was noted that for lower building height Height determines the base shear difference with respect to the SRSS technique, and the difference gets less as building height goes up.

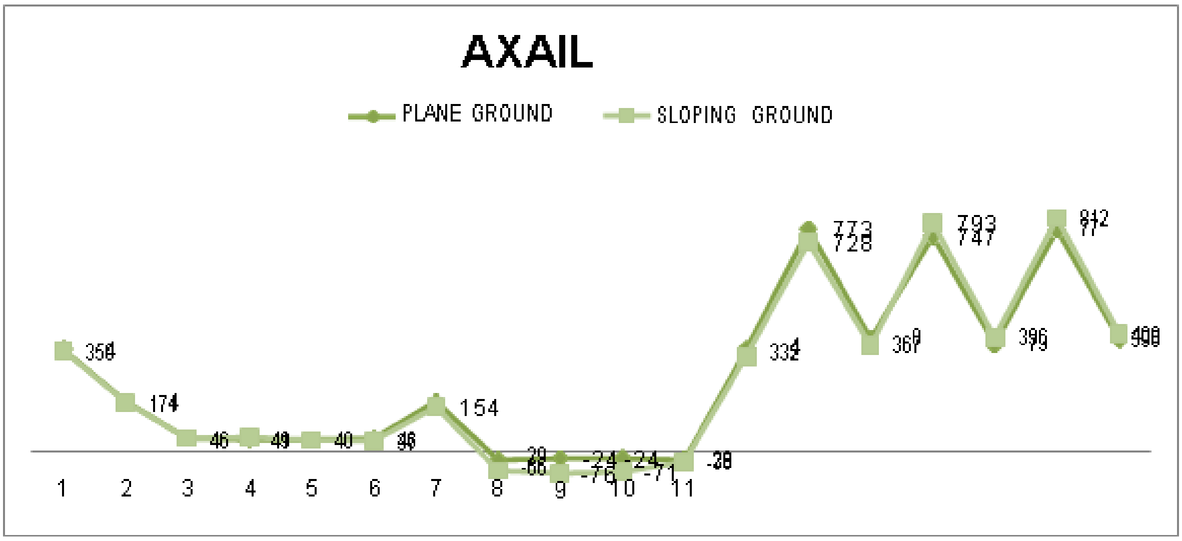
Mahfujur et al. (2021) and comparison of the values of the estimated moment coefficients with Structure analysis and design take up a sizeable amount of the Civil Engineering Division's work. The discipline of structural engineering significantly relies on slab analysis and design to ensure infrastructure sustainability, durability, and economic feasibility. The most crucial field for structural engineers is two-way slab analysis. Analysis and design of two-way slab structural elements that are effective are inversely related to project costs. This article also explains how to use STAAD Pro.-2006, a structural analysis and design programme, to calculate a two-way slab's moment coefficient for a variety of two-slab circumstances. A comparison between the calculated moment coefficients and the relevant American Concrete Institute (ACI-318-14) values is also made. Utilise the STAAD Pro-2006 programme for various situations (as per ACI-318-14) and differential ratios to develop a two-way slab model and obtain the coefficient data. Results data are compiled by the American Concrete Institute (ACI-318-14).Vignesh and others (2021) Tall structures are vulnerable to severe damage as a result of lateral stresses, including seismic and wind loads. This injury results in a significant loss of life.to introduce shear walls in order to innovate the building's specifications. STAAD Pro V8i was utilised to conduct the study, which looked at the deflection, bending moment, shear force, wind load, and other factors.

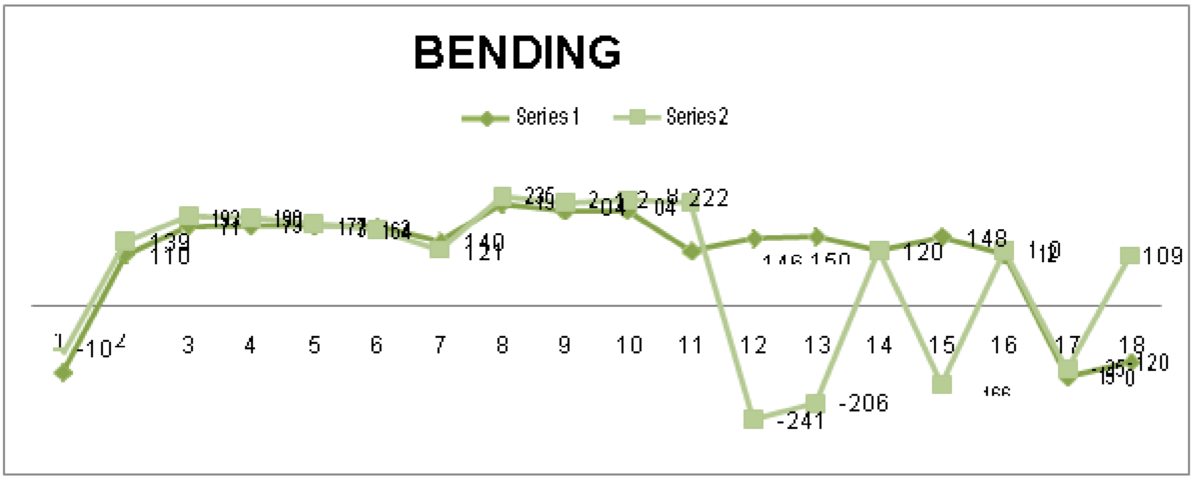
III. Analysis results for 4 bay systems on plane and on a sloping ground for two story frame.

Beam No	Maximum Axial Force		Maximum Shear Force		Maximum Bending Moment		Maximum Tensile Force		Maximum Compresssive Force	
	kN		kN		kN-m		N/ mm^2		N/ mm^2	
	P*	S*	P	S	P	S	P	S	P	S
1	-7	4	354	350	9	7	-55	-31	-141	-102
2	-7	7	174	171	7	9	-61	-62	110	139
3	11	11	46	46	11	11	-201	-203	171	193
4	10	11	41	49	10	11	188	206	173	190
5	10	10	41	40	10	10	-188	190	173	177
6	11	9	46	37	11	10	201	182	172	164
7	7	6	174	154	9	8	61	47	140	121
8	13	13	-29	-66	13	14	-194	-198	219	235
9	12	13	-24	-76	12	12	-187	-190	204	221
10	12	13	-24	-71	12	13	-187	-206	204	228
11	13	13	-29	-36	12	13	194	+196	119	222
12	7	10	354	332	10	15	62	103	146	-241
13	7	10	773	728	11	14	-64	-66	150	-206
14	6	6	390	367	7	8	-55	54	120	120
15	7	8	747	793	11	12	63	53	148	-166
16	6	6	373	396	7	8	-51	59	112	120
17	7	7	772	812	11	10	51	43	-150	-135
18	6	5	390	409	8	7	56	50	-120	109

[P= Plane ground, S= Sloping Ground]*







IV. Conclusion

Based on the above study following conclusions can be made:

- choosing construction sites that are best suited for ground shaking and ground failure in terms of frequency of occurrence and likely severity; providing high-quality construction that complies with relevant IS codes like IS 1893 and IS 13920 to guarantee good performance during future earthquakes.
- To put into practise the analysis-based design of the building's components and the connections between them. For examples, ductility design needs to be done.
- It is important to use structural-spatial solutions that provide symmetry and consistency in the distribution of mass and stiffness in plan and elevation.

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